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Determination of Heavy Metals in Edible Palm Oil Adultrated with Plant Dye: Experimental Investigation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

From generation to generation, edible palm oil has been a staple of the human diet and has improved both nutrition and health. The goal of the current research was to determine whether it was possible to tamper with palm oil by adding natural potash (lake salt) and red dye made from the leaf sheath of sorghum bicolor. In order to create tainted palm oil with known concentrations and adulterant ratios, concentrations of potash and red dye ranging from 0.01-0.1% and 0.1-1.0%,

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respectively, were produced in water and added to fresh palm oil at oil/adulterant ratios ranging from 10:1-10:10. Adulterated samples underwent visual inspection for appearance, as well as sensory evaluation for quality indicators. Even at concentrations below 0.01%, the addition of potash caused the typical orange red hue of palm oil to become yellowish red, and it also produced a product with improved consistency. Zn 8.060.06, Cd 1.010.05, Ni 1.000.00, Co 125.910.09, Pb 9.300.07 Cobalt, Lead, and other heavy metals were found to be over the detectable level of the WHO standard, whereas Cd and Ni were within the permissibility limit. The findings of this study suggest that if sufficient oversight is not provided by regulatory bodies, palm oil might pose a risk to the public's health. As a result, from the point of production to the point of consumption, our local processed palm oil has to be better screened.

Keywords: Heavy metals; oil palm; plant dye.

1. INTRODUCTION

A monocotyledon, or plant that grows from the centre, is the oil palm. It only develops one leaf at a time, with the leaflets pressed together as it emerges from the apex. When each leaf's capacity for photosynthetic growth increases, it then spreads its leaflets. A palm tree may grow to a height of 20 metres and survive for up to 65 years [1]. Due to the succession regime that oil palm has evolved to, the palm was able to thrive in a less than ideal location. The palm is an early successional plant that thrives in high tropical forest-friendly conditions. Because of this, oil palms can only grow in the forest environment on riverbanks or in places where a hole is made to enable enough sunlight [2].

The fuel the most significant oil-producing plant in West Africa is the palm (Elaeisguinensis). Two different forms of oil are produced by the fruit: orange-red crude palm oil that is taken from the mesocarp and brownish-yellow crude palm kernel oil that is extracted from the seeds (kernel). The former is mostly made up of palmitic and oleic acids, whereas the latter is primarily made up of lauric acid. In the global commerce, both oils are significant. The richest natural source of carotenoids and tocotrienols is crude palm oil. At tropical room temperature, the presence of triacylglycerols of palmitic and oleic acids is primarily what causes the semi-solid consistency. Carotenoids (500–700 ppm) are what give the substance its distinctive deep orange-red hue [3].

The dried kernels of the oil palm, Elaeis Guinensis, are used to make palm oil, which is the second most popular oil in the lauric acid group. Less than 5% of all natural fats and oils are made up of palm oil, yet it is a significant source of raw materials for the oleochemical industry. Due to the high concentration of bioactive lipid components in nuts and seed oils, which have demonstrated a variety of health advantages, there is increased interest in these foods. The kernel of the oil palm Elaeisguinensis is the source of palm oil, an edible plant oil. At room temperature, palm mesocarp oil is semisolid and 41% saturated. It contains both saturated and unsaturated fats in the forms of glyceryllaurate (0.1%), myristate (1%), palmitate (44%), stearate (5%), oleate (39%), and linoleate (10% polysaturated) [4].

Heavy metals are naturally occurring elements with large atomic numbers and densities that are at least five times greater than those of water. The Earth's crust contains the majority of heavy metals. Heavy metals are difficult to break down. Heavy metal contamination in food is frequently brought on by environmental and industrial pollution [5]. Environmental pollution and food poisoning with heavy metals were related by Esterhuyse et al. [6]. Contaminated soil, water, and air are additional ways that people might be exposed to heavy metals [7]. It could also originate from the raw materials used to produce the particular food items and water.

In recent years, research on the toxicological consequences of heavy metals on human health and nutrition has grown. While some elements, like Cu, Zn, and Fe, can operate as nutrients and are vital to human health, others, including Ni, Pb, Cd, As, and Hg, may be hazardous to people if taken in excess [8]. Because of their destructive effects on life, heavy metals are regarded as significant inorganic pollutants [9,10]. The body absorbs the heavy metals through food and breathing. The intake by ingestion is influenced by eating habits. Pb and Cd are known to be harmful, and children are more sensitive to them than adults are Heavy metals' toxicological impact on human health and Cu and Zn are two metals that are crucial

micronutrients and have a wide range of metabolic functions in all living things. Although though Cu and Zn are necessary, they can be hazardous if consumed in excess. Tolerance and necessity differ from element to element [11].

In Nigeria, there is widespread concern that crude palm oil is being tampered with. It is thought that manufacturers engage in adulteration solely to improve the yield of PALM OIL and maximise their profits. Sadly, the practise of adulteration is typically carried out without taking into account its potential impact on the quality of palm oil and the health of customers. Carrot, papaya, natural potash, and red dye are among the allegedly utilised adulterants; potash and red dye are the favoured and most commonly used adulterants because to their abundance and inexpensive cost [12]. Natural potash, commonly referred to as lake salt and locally known as "kanwa," is a mineral made up of carbonates, sulphates, and chlorides of sodium, calcium, and potassium as well as a few other elements some micronutrients [13]. Moreover, kanwa is a culinary condiment that is used in the region as a soup thickening, a meat tenderizer, and an emulsifier between oil and water. On the other hand, red dye is an aqueous extract of the sorghum bicolor leaf sheath that has been dried [14]. The plant, which grows in Northern Nigeria under the name "Karan dafi," produces a red dye that is frequently used to colour leather, garments, calabashes, and the human body.

The fact that these substances have not undergone rigorous research and the amount of damage they may represent to human health when taken is not well known is one of the main issues related to the usage of adulterants. Adulteration in crude palm oil might cause the oil to lose its nutritional value, organoleptic qualities, and overall quality [15]. This research sought to determine whether it was possible to tamper with palm oil by adding potash and red dye made from the sorghum bicolor leaf sheath. Also, an effort was undertaken to create a quick, easy, and accurate test for determining contaminated crude palm oil.

1.1 Statement of the Problem

Certain physico-chemical characteristics of an oil can be used to determine its quality. The precise value of certain of these characteristics gives a hint as to the oil's nutritional and physical qualities. Due to its high levels of natural antioxidants and vitamins, excellent oxidative stability, and extended shelf life, palm oil has just overtaken olive oil as the second most consumed oil in the world. The fact that these substances have not undergone rigorous research and the amount of damage they may represent to human health when taken is not well known is one of the main issues related to the usage of adulterants. Adulteration in crude palm oil might cause the oil to lose its nutritional value, organoleptic qualities, and overall quality. There is no published research on the adulteration of palm oil with non-oil products such potash and red natural dye. This project's goal was to look into the possibilities of tainting palm oil with potash and red dye derived from sorghum bicolor's leaf sheath.

Customers have faith that the oils they purchase are secure and of the highest calibre. Moreover, they anticipate receiving information that will enable consumers to choose products wisely and assurances that the information on product labels is accurate and not deceptive. Hence, it is appropriate to analyse the heavy metals present in drinks, such as lead, nickel, manganese, zinc, cadmium, and chromium, in order to give cautionary usage of the beverages and a foundation for sensitising government authorities.

The study's goals are to identify the physicochemical characteristics of palm oil that has been tampered with by adding red sorghum bicolor dye to the leaf sheath and to identify the heavy metal content of those physicochemical parameters.

The focus of this study is to evaluate a few particular heavy metals and physicochemical properties in palm oil that has been tampered with to add red sorghum bicolor leaf sheath dye.

1.2 Significance of Study

Several of the red oils sold in Nigerian marketplaces are thought to meet the NAFDAC/WHO threshold for metal content. This investigation will be very important since it will determine whether the amount of heavy metals in this oil truly complies with the required requirement.

The study will be helpful to oil consumers since it will help them understand how much heavy metal is in their oil and why they should avoid certain beverages if the results indicate a high level of content. This will inform customers about the

physicochemical composition of palm oils available on the market and assist them in choosing which brand to purchase.

2. MATERIALS AND METHODS

2.1 Materials

Oven, weighing balance, heating mantle, volumetric flask, conical flask, spatula, watch glass, AAS.

2.2 Sample Collection

The crude palm oil utilised in this study was produced in the lab using freshly picked, ripe palm fruits that were bought from Eke Awka in order to ensure the absence of any adulterants of any kind. While the potash and red dye used as adulterants were bought from a nearby grocery shop, the fruits were provided by a local palm oil processor.

2.3 Sample Preparation

According to Matthaus [16], fresh palm fruits were parboiled in a cooking pot to avoid enzymatic deterioration and to soften the fruit's mesocarp for simple pounding. The fruits were then mashed until pulp and nuts were produced using a wooden pestle and mortar. The nuts (palm kernels) were taken out, the pulp manually pressed to extract a red viscous fluid (oil, fibre, water, contaminants), heated to cause water traces to evaporate, and then sieved through a metal basket to extract a clear red palm oil.

2.4 Sample Adulteration

About 1g of potash or red dye was dissolved in 100ml of distilled water, and the solution was then diluted with distilled water to the desired concentrations. The resulting aqueous potash and dye solutions had concentrations ranging from 0.01-0.1% and 0.1-1.0%, respectively. In order to reduce the viscosity of the oil, 145 clear plastic vials of 25ml each were filled with precisely 10g of the freshly processed palm oil. The vials were then warmed in a water bath set at 45oC. Following the ratios stated in Table 1, potash solutions were then added to 50 of the vials and dye solutions were added to the remaining 95. For example, a 0.10% adulterant concentration and a matching 10:1 oil/adulterant ratio show that 1ml of a 0.1% adulterant solution was added to 10g of fresh red palm oil. The samples appeared anxious, capped, then kept on the lab's shelves with dimmer lighting and visually examined (for colour and appearance) every 24 hours for 30 days. The control was made up entirely of fresh red palm oil. The study only kept samples whose colour and consistency were similar to those of the control during the whole storage period, excluding samples whose appearance deviated marginally or significantly from that of the control.

2.4.1 Maintenance of sample

In sterile containers, samples were kept at room temperature until they were promptly transferred in sterile canisters to the laboratory for examination.

2.4.2 Moisture content determination

Used was the Moats and Rimu [17] approach. 5ml of the sample was weighed into crucibles that had been cleaned, dried, and preweighed. The moisture extraction oven dried the crucibles and their contents for one hour at 1050C. The samples were then taken out of the oven, allowed to cool, and weighed again. The samples were once more placed inside the oven and dried until they reached a consistent weight. The study was performed three times, and the average result was noted as the moisture content.

$$\%\ Moisture\ content = \frac{Initial\ weight\ of\ sample - weight\ of\ oven\ dried\ sample\ X\ 100}{Initial\ weight\ of\ sample}$$

2.5 Determination of Specific Gravity (AOAC, 2005)

2.5.1 Procedure

Weigh empty SG bottle and note the weight.
Fill the bottle with distilled water.
Weigh again and note the weight of the bottle and water.
Fill the bottle with the oil.
Weigh again and note the weight.

CALCULATION

$$SG = \frac{weight\ of\ the\ oil\ (g)}{Weight\ of\ distilled\ water}$$

2.5.2 pH

A clean, dry 25 ml beaker was filled with around 2g of the oil sample. The sample was then put to

the beaker along with 13ml of hot distilled water, which was slowly swirled. Afterwards, it was chilled to 25oC in a cold-water tank. The PH electrode was calibrated with buffer solution before being submerged in the sample to read and record the PH value.

2.5.3 Melting point determination (JIS K 007-1992)

Each oil was placed in a capillary tube, left to freeze for one hour, and then slowly warmed in a water bath. The slip point, also known as the melting point, was the temperature at which the oil started to slip in the capillary tube.

2.5.4 Determination of iodine value [18]

One (1) millilitre of oil was mixed with twenty-five (25) millilitres of iodine monochloride, stoppered, and allowed to stand for one (1) hour next to a blank that had 10 millilitres of chloroform added in its place. 10 ml of a 10% KI solution was added after the flask had been washed with 50 mL of distilled water. As the freed iodine reached a brownish yellow colour, it was promptly titrated with 0.1 M Na2S2O3 before 1 mL of starch solution indicator was added. It was necessary to keep up the titration until the produced blue colour vanished. The iodine value was determined using the Na2S2O3 volume.

$$Iodine\ value = \frac{(Blank - Titre\ value) * molarities\ of\ Na2S2O3 * 12.69}{Weight\ of\ sample\ gm}$$

2.5.5 Determination of saponification value (JIS K 007- 1992)

Approximately 25 mL of an alcoholic potassium hydroxide solution (0.5 M) was refluxed with two (2) grammes of the oil for one (1) hour while being frequently shaken. 0.5 M hydrochloric acid and 1 mL of phenolphthalein indicator were used to titrate the surplus alkali. Alongside, a blank titration was performed, and the saponification value was computed as follows:

$$Saponification\ value = \frac{(Blank - Titre\ value) * 28.05}{Weight\ of\ oil\ (g)}$$

2.5.6 Determination of free fatty acid of the oil [19]

Warming up a beaker, adding around 1 g of the essential oil, stirring it thoroughly, adding 25 ml of methanol, 2 drops of phenolphthalein indicator, and a drop of 0.14 N NaOHsolution. After a bright pink colour that lasted for approximately a minute was seen, the mixture was titrated against a NaOH solution. The end-point was noted, and the free fatty acid was determined using the equation below.

$$FFA = \frac{(titer\ value\ x\ N\ x 28.2)}{Weight\ of\ oil}$$

Where FFA denotes the free fatty acid and N is the normality of the base.

2.5.7 Determination of acid value of the oil

About 2g of the oil sample was weighed into a conical flask with 50 ml of isopropyl alcohol to calculate the oil's acid value. The mixture received 3 drops of phenolphthalein indicator. The resultant mixture was titrated against 0.1 M NaOH [19] to determine the acid value of the oil using Equation.

$$Acid\ value = \frac{(5.61\ x\ titer\ value)}{Weight\ of\ sample}$$

2.5.8 Peroxide value determination (Eddy et al. 2011)

Glacial acetic acid and chloroform [2:1] v/v solvent combination was added to one (1) gramme of the oil sample and allowed to boil for 30 seconds before being stirred rapidly for an additional 30 seconds. The boiling tube was then rinsed twice with 25 mL of distilled water after being put into 20 mL of 5% potassium iodide. Starch indicator was used to titrate this with 0.002 M Na2S2O3, and a blank was also titrated in a similar manner. Calculation

$$Peroxide\ value = \frac{1000(V2 - V1)T}{M}$$

Where M = mass of oil taken (1 g); V2 = volume of 0.1 N Na2S2O3; V1 = volume of 0.1 N Na2S2O3 used I blank and T = normality of Na2s2O3 (0.1 N).

2.6 Heavy Metal Analysis

2.6.1 Preparation of sample

The material was homogenised and dried to dryness in an oven at 1050C. In a fume hood, 12 ml of concentrated HNO3 was introduced to a conical flask that had been carefully calibrated to hold 10g of sample, and the flask was covered

with a watch glass. Samples will be dried-out heated and cooled in a heating mantle. Conc. HNO3 and HCLO4 will also be added, each in 10ml. Samples will be slowly evaporated on a heating mantle until thick, white HCLO4 vapours are visible. The sample was boiled to remove any chlorine or nitrogen oxide after being cooled and diluted to 50ml with distilled water. The sample was filtered, cooled, and then put into a 50 ml volumetric flask, which was then filled to the proper level with distilled water.

2.6.2 Preparation of standard solutions

The 1000 ppm Standard Stock Solution of GFS Fishers' AAS Reference Standard will be used to create standard solutions for lead, cadmium, copper, and nickel. These stock solutions will be serially diluted to provide lead concentrations of 0.5, 1.5, and 2 ppm, cadmium concentrations of 0.5, 1, 1.5, and 2 ppm, copper concentrations of 0.5, 1, 1.5, and 2 ppm, and nickel standards of 0.5, 1, 1.5, and 2.

2.6.3 Digestion of samples

The same approach will be used to digest every sample. Each sample received 10 ml of digested acid (3:1 HCl:HNO_3) after being pipetted into a digestion test tube with care at a weight of 5gm each sample. This was set for 30 minutes on the hot plate. When digestion is complete, the digested samples are made up to 50 ml with distilled water and allowed to cool to room temperature. The samples are then filtered (with man filter paper No. 41) and placed into volumetric flasks for analysis by flame atomic absorption spectroscopy (FAAS).

3. RESULTS

The result for the physical and chemical properties of the unadulterated and adulterated palm oil used in the study are presented in Tables 1 and 2.

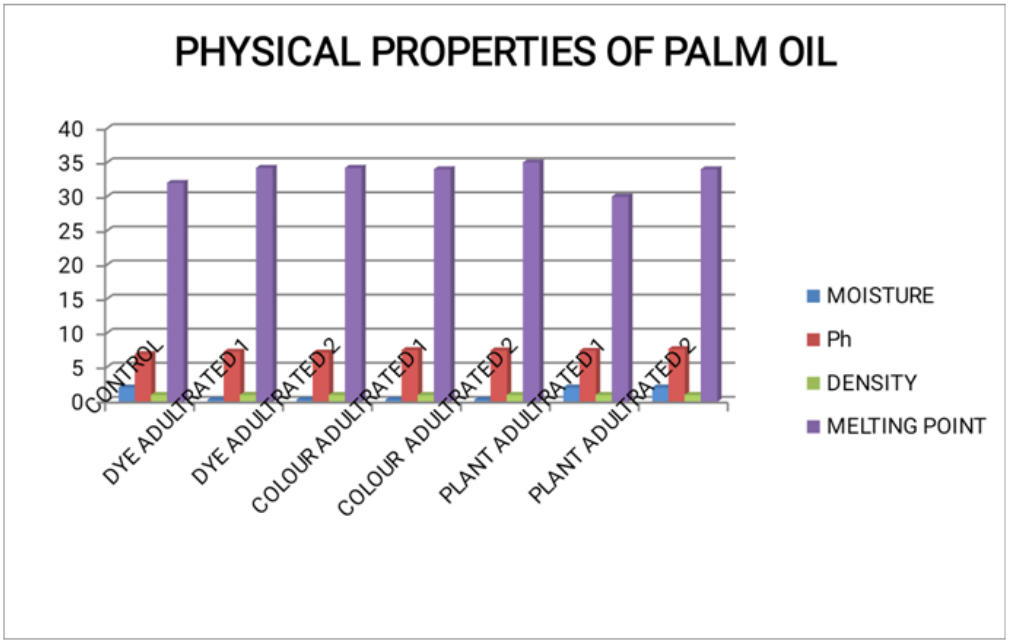

Fig. 1. Physical properties of palm oil

Table 1. Physical properties ofunadulterated and adulterated palm oil used in the study

Sample	Moisture	Ph	Density	Melting point
Control	0.50	6.89	0.91	32
Dye adultrated 1	0.20	7.25	0.92	34.2
Dye adultrated 2	0.20	7.13	0.91	34.2
Colour adultrated 1	0.20	7.47	0.9	34
Colour adultrated 2	0.20	7.43	0.91	35
Plant adultrated 1	1.2	7.38	0.91	30
Plant adultrated 2	1.2	7.63	0.91	34

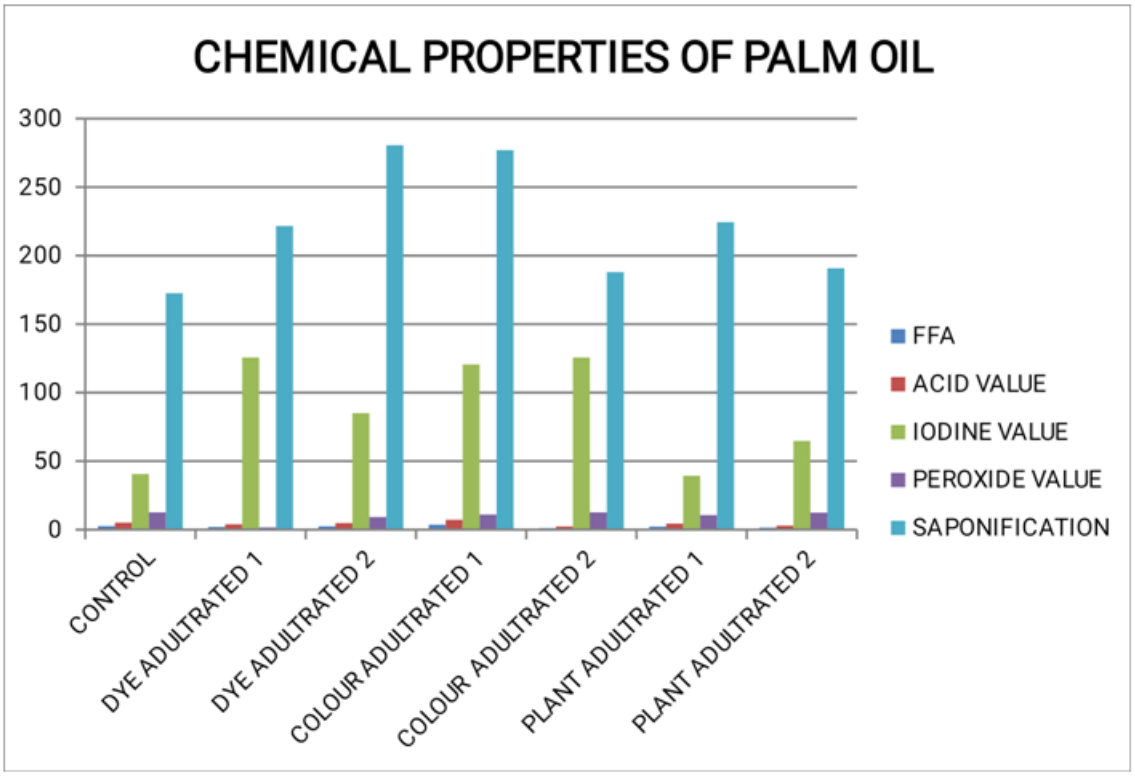

Fig. 2. Chemical properties of palm oil

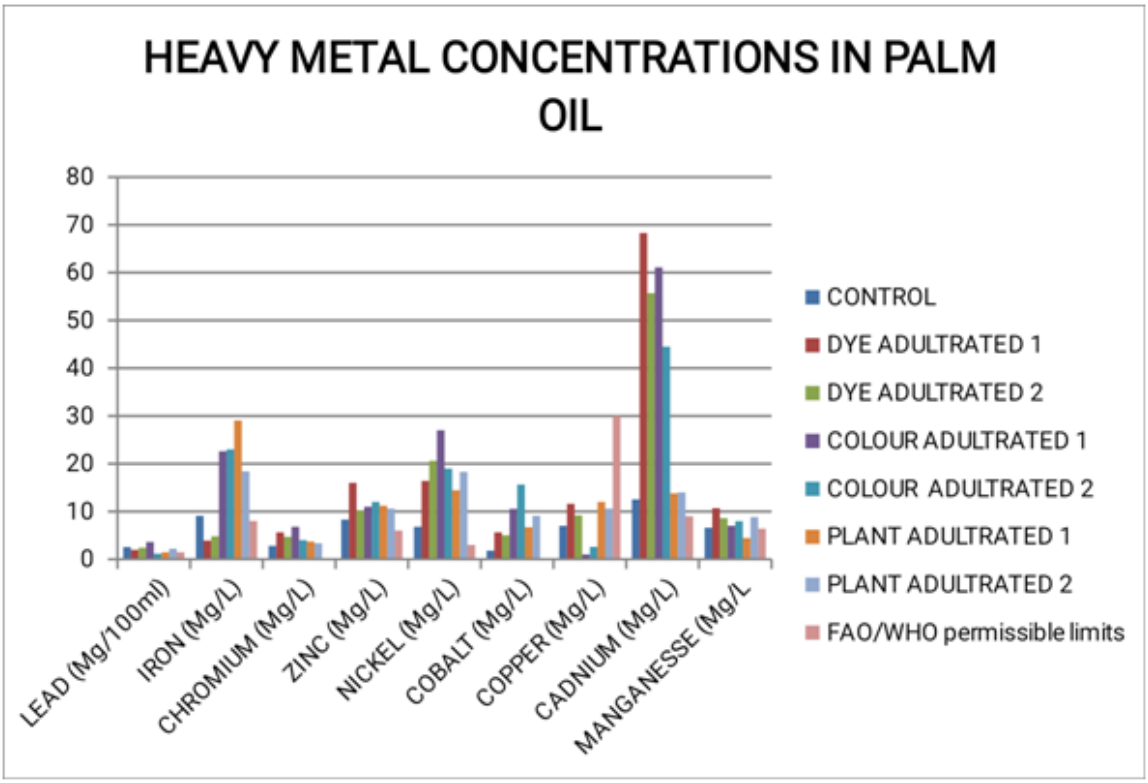

Fig. 3. Heavy metal concentrations in palm oil

Table 2. Chemical properties of unadulterated and adulterated palm oil used in the study

Sample	FFA (%)	Acid value (Mg)	Iodine value (g)	Peroxide value (Millieq/kg)	Saponification value (Mg/KOH)
Control	2.56	5.10	40.60	12.6	172.53
Dye adultrated 1	1.96	3.90	125.63	1.6	221.63
Dye adultrated 2	2.41	4.80	85.02	9.2	280.6
Colour adultrated 1	3.61	7.20	120.55	11	277
Colour adultrated 2	1.15	2.30	125.63	12.6	187.97
Plant adultrated 1	2.21	4.40	39.34	10.6	224.44
Plant adultrated 2	1.46	2.90	64.72	12.4	190.77

Table 3. Heavy metal concentrations in unadulterated and adulterated palm oil used in the study

Sample	Lead (Mg/100ml)	Iron (Mg/L)	Chromium (Mg/L)	Zinc (Mg/L)	Nickel (Mg/L)	Cobalt (Mg/L)	Copper (Mg/L)	Cadnium (Mg/L)	Manganess e (Mg/L
Control	2.56	9.1	2.8	8.3	6.8	1.8	7	12.53	6.6
Dye adultrated 1	1.96	3.9	5.63	16	16.4	5.63	11.6	68.3	10.7
Dye adultrated 2	2.41	4.8	4.7	10.2	20.6	5.02	9.2	55.7	8.6
Colour adultrated 1	3.61	22.6	6.8	11	27	10.55	1	61.1	7
Colour adultrated 2	1.15	23	4	12	18.97	15.63	2.6	44.5	7.97
Plant adultrated 1	1.46	29.06	3.7	11.2	14.44	6.7	12	13.8	4.44
Plant adultrated 2	2.21	18.4	3.34	10.6	18.3	9.1	10.6	14	8.83
FAO/WHO permissible limits	1.46	8	0.1	6	3	0.06	30	9	6.4

3.1 Heavy Metal Analysis

The result of the heavy metal analysis in the unadulterated and adulterated palm oil used in the study are shown in Table 3.

4. DISCUSSION

The vivid crimson of the adulterated samples, which were made using dye solutions with concentrations over 1%, was noticeably more intense than the recognisable orange-red hue of the control. Similarly, dye concentrations less than 0.1% resulted in light-red hue that was noticeably paler than the control. Hence, 0.10 and 1.0% were chosen as the lowest and maximum dye solution concentrations, respectively. Potash solutions at concentrations of 0.01% and higher increased the volume of palm oil by up to two times while also changing the oil's natural orange red hue to a yellowish red and giving the final product a thick viscosity. Nevertheless, using potash solutions at levels below 0.01% led to the formation of two immiscible liquid phases. As a result, potash was disqualified from further research since it was thought to be far from an ideal adulterant. Hence, attention was drawn to a red colour that seemed to be a typical adulterant in palm oil.

Table 1 compares the fresh palm oil's quality indicators to those of a representative adulterated sample. FFA, one of the most crucial quality indicators in the palm oil business because it shows how far the oil has degraded, recorded readings of less than 3.5%, which is considered to be the typical acidity for commercial crude palm oil [20]. This suggests that the palm oil utilised in the current investigation was made from recently harvested, ripe fruits with minimal endogenous lipase activity (triacylglycerol acylhydrolase). According to Hartley and Wellnitz [21], red dye adulteration decreased the value of FFA in oil palm fruits (due to dilution effect of the dye solution). Values for peroxide followed a similar pattern. Both the contaminated and unadulterated samples had identical oil colour indices, and both samples' iodine levels and fatty acid composition fell within the stated parameters for palm oil [22]. According to the aforementioned findings, measuring standard oil quality measures by itself would not be adequate to spot palm oil tainted with red dye.

There have been discoveries of heavy metals that are beyond the permitted limit. In the biological system, heavy metals can bioaccumulate and provide a possible health concern to consumers over a long period. in fruit from oil palm [21] It also contends that the value of was diminished by red dye adulteration Depending on where the palm oil sample from this research was taken, the concentration of heavy metals varies. The body needs zinc, which is a required heavy metal. According to Resnick et al. [23], a daily need of 15-20 mg of zinc exists. Based on the findings of these research, zinc content was noticeably increased but still within the acceptable range. The majority of metallo enzymes must operate, making zinc the most crucial vitamin for human health. Zinc used orally can result in symptoms such as vascular shock, vomiting, dyspeptic nausea, diarrhoea, tachycardia, pancreatitis, and damage to the hepatic parenchyma Reeves et al. [24]. By interacting with certain metallothione near the brush edge of the intestinal lumen, a high concentration of zinc may lead to absorption, according to Wallis et al. [25]. Our findings indicate that cadmium, another dangerous heavy metal, has been discovered in the studied palm oil. Compared to the control market, cadmium levels have significantly increased across all of the examined markets. It has been determined that cadmium exposure and lung absorption range from 10 to 50%, although stomach absorption is lower. In non-polluted locations, the average consumption or daily intake ranges from around 10 to 40 ug, according to a WHO assessment from 2004. Long-term daily cadmium intake of between 140 and 260 ug has been linked to renal tubular damage in humans. In addition, the concentration at which cadmium becomes dangerous depends on the health and condition of the person. When cadmium is present in immune-compromised people at lower concentrations than in healthy people, it is frequently harmless.

Environmental pollution and other sources of cadmium exposure may cause substantially lower levels of development. Findings have showed that cadmium exposure from our ready-to-eat food may cause bone damage in both people and animals, according to research. Our regular consumption of food sources including seeds, the roots of plants, fruits, and even leaves provides a concrete illustration. Every year, nickel is released into the environment as a result of

burning fossil fuels. According on the findings of the current investigations, nickel levels in one of the chosen marketplaces were substantially higher than in the control. Hence, research has revealed that the daily consumption of nickel in the human diet is around 165 mg. This means that the nickel was within the acceptable range [26]. While its functional efficiency has not been shown, the presence of nickel in plants implies that nickel is an essential trace element in animals. Nickel is regarded as essential since it is lacking in animal foods. A deficit of nickel may be formally detected in the liver, but it also has unfavourable effects on cellular architecture and lipid levels. Moreover, nickel may inhibit development, promote haemoglobin condensation, and impair glucose metabolism, according to the ATSDR (2003). In these experiments, the cobalt content was higher above the acceptable level. The body needs cobalt, which is a component of cyanocobalim (Vit B12). The liver is where it is concentrated in big amounts. The synthesis of vitamin B12, which is necessary for the creation of red blood cells and the prevention of pernicious anaemia in both humans and animals, involves cobalt. Moreover, cobalt was discovered to be within Zittermann and Koerfer's [27] suggested permissibility range. According to previous study, vitamin B12 and other chemical substances contain roughly 0.03 ug of cobalt per microgram. It can be used as a medicinal agent to treat cyanide poisoning and anaemia. Cobalt levels that are higher in food and water don't usually build up inside of a person's body. Although another investigation on goiter showed a greater frequency in some areas, cobalt is eliminated in urine. Wallis and co. [25]. The most pervasive poisonous metal, lead, may be found in some degree in every element of the environment. Lead is a well-known neurotoxic that can damage children and induce bone mobilisation during pregnancy and breastfeeding, according to the ATSDR (2004). In both male and female animals, lead exposure has long been linked to sterility and a gemetotoxic impact. According to certain clinical investigations, lead can enter the foetus through the placenta and disrupt its development before birth. Research have also revealed that exposure to high levels of lead may result in chromosomal problems in workers and immune system suppression, as seen in test animals Merke [18]. According to this investigation, the lead content was higher than allowed [28,29].

5. CONCLUSION

According to the findings, it may not be possible to detect palm oil tainted with red dye by measuring the standard quality characteristics of fats and oils. The dispersion of scarlet particles inside the colourless oil or the significant reduction in volume can be a clear indicator of adulteration even in the absence of a control sample. Also examined as a possible adulterant was dye. While this substance raised the volume of palm oil by up to threefold and demonstrated strong oil/water binding abilities, it also transformed the distinctive orange red hue of palm oil to a yellowish red even at concentrations below 0.01% and produced a product with improved consistency.

This research demonstrates that both pure and contaminated palm oil contain measurable levels of a few chosen heavy metals. The data show that every heavy metal that was chosen was below the allowable level. Lead and cobalt levels were over the allowable range. The exposure of the palm oil during processing, storage, and packaging may have exposed the palm oil to environmental conditions that made it unfit for eating, contributing to the high concentration of several of the chosen parameters employed in these investigations.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Akinoso R, Olayanju TMA, Bankole LK. Design, fabrication and testing of a roaster for palm kernel (Eleaisguineensis) kernel; 2018.
2. Jacobs erg, 2013, AE. Physicochemical Studies on oils from five selected Nigeria plant seeds. Pak. J. Nutr. 2017;6:75-78.
3. Henderson. Bio Availability and vitamin A value of carotenes from red palm oilassessed by an extrinsic isotope reference method. Journal Cereb. Blood Flow Metab. 2015;31(10):2218-2230.
4. Cook S, Gallagher J, McIntyre L, Suter A, Tan J. An open study to assess the safety and efficacy of aesculushippocastanum tablets (Aescula force 50mg) in the treatment of chronic venous insufficiency: J. Herb Pharmacother. 2017;4:19-32.

5. Gutteridge, Thornton. Quality changes of RBD palm olein soybean oil and their blends during deep – fat frying. Plant Foods Human Nutrition. 2015;57(4):319-341.
6. Esterhuyse AJ, Toit ED, Rooyen JV. Dietary red palm oilsupplementation protects against the consequences of global ischemia in the isolated perfused rat heart. Asia Pac. J. Clin. Nutr. 2015;14:340-347.
7. Matthaus BU, Senger CA, Lin JS, Whitlock EP. Vitamin and mineral supplements in the primary prevention of cardiovascular disease and cancer. An updated systematic Evidence Review for the U.S Preventive Services Task Force. Annals of Internal Medicine. 2017;159 (12): 824-34.
8. Fukuwatari T, Shibata K. Urinary waters-soluble vitamins and their metabolite contents as nutritional marketers for evaluating vitamin intakes among young Japanese women. J. Nutr. Sci. Vitaminol. 2018;54(3):223-3.
9. Giovannucci, Kikuchi H. Assessment of tailor-made prevention of atherosclerosis with folic acid supplement; randomized, double-blind, placebo-controlled trials in each MTHFR (677T genotype. J. Hum Genet. 2018;50:241-8.
10. Giovannucci NA, Ichim TE, Riordan NH. Anti-angiogenic effect of high doses of ascorbic acid. J. Tansi Medi. 2018;6:50.
11. Gutierres B, Mouren X, Caillard P, Schwartz F. Study of the antiischemic action of EGb 761 in the treatment of peripheral arterials occlusive disease by TCP 02 determination. Angiology. 2019;45:413-17.
12. Hodge WH. Oil producing palms of the World. A review Principles. 2015;19(14):119-136.
13. Holick AF, Kok FJ, Ringstad J. Antioxidants in adipose tissue and risk of myocardial infarction: The EURAMIC Study. Lancet. 2021;342:137-148.
14. Kanfman L, Wiesman T. Homocysteine lowering and Cardiovascular events after acute myocardial infection. Engl J. Med. 2017;354:1578-88.
15. Maqbool A, Stallings VA. Update on fat-soluble vitamins in cystic fibrosis. Curr. Med. 2018;14(6):574-81.
16. Matthaus B. Use of palm oilfor frying in comparison with other high stability oils. Eur. J. Lipid Sci. Technol. 2017;109(4) :400-409.
17. Moats C, Rimu EB. Vitamin intake and risk of coronary disease: Observation versus intervention. Curr. Res. 2017;9:50-58.
18. Merke J, Milde P, Lewicka S. Identification and regulation of 1,25-dihydroxyvitamin D3 receptor activity and biosynthesis of 1,25-hydroxyvitamin D3. Studies in cultured bovine aortic endothelial cells and human dermal capillaries. J Chin Invest. 2019;83:1903-15.
19. Onyegbado CO, Iyagba ET, Offor OJ. Solid Soap production using plantain peel ash as source of alkali. J. Appl. Sci. Environ. Manage. 2022;6(1):73-77.
20. Nwanyi VM, Ezeike AK, Onyejekwu IC, Igboeli CN. Basic Concepts in Modern Biochemistry. African Journal of Food Science. 2015;63:181-187.
21. Hartley, Wellnitz B. Association of vitamin A deficiency with heart failure and sudden cardiac death in a large cross-sectional study of patients referred for coronary angiography. J. Clin Endocrinol. Metab. 2018;93:392-415.
22. Rasol AH, Rahman AR, Yuen KH, Wong AR. Arterial Compliance and vitamin E blood levels with a self-emulsifying preparation of tocotriend rich vitamin E. Arch. Pharm Res. 2018; 31:1212-7.
23. Resnick LM, Muller FB, Laragh JH. Calcium regulating hormones in essential hypotension: Realtion to plasma renin activity and sodium metabolism. Ann. Intern. Med. 2016;105:649-54.
24. Reeves A, Weihrauch, Mc Dowell IF, Moat SJ. Folic acid improves endothelial function in coronary artery disease via mechanisms largely independent of homocysteine lowering. Circulation. 2019;105:22-6.
25. Wallis DE, Penckofer S, Sizemore GW. The “Sunshine deficit” and Cardiovascular disease. Circulation. 2018;118:1476-1485.
26. Zakaria M, Simpson K, Brown PR, Krstulovic A. Use of reversed phase high performance liquid chromatographic analysis for the determination of provitamin A. carotenes in tomatoes. Journal of Chromatography. 2018;176:109-117.
27. Zittermann A, Koerfer R. Vitamin D in the prebention and treatment of coronary heart disease. Nutr. 2018;11:75-79.

28. Gutteridge A, Thornton JM. Understanding nature's catalystictoolkit. Trends in Biochemical Sciences. 2015;30(11): 622-29.

29. Pearce BC, Wright JJ, Gapor A, Elso CE. Response of hypercholesterolenic subjects to administration of Tocotrienols. Lipids. 2015;30:1171-1177.

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